6. *Hyperbæna Domingensis,* Benth. (in parte), l. c. 50;—Cocculus Domingensis, *DC. Syst.* i. 528, *Prodr.* i. 99; *Deless. Icon.* i. tab. 96; *Griseb. Fl. Br. W. Ind.* p. 10;—Anelasma Domingensis, *nob. olim, l. c.* 43;—Pachygone Domingensis, *Eichl. l. c.* 197.—In Antillis, ♂, San Domingo (Poiteau): *v. s. in herb. Hook.* ♂, Villa Monte Verde, Cuba (Wright, 1105), Domenica (Imray, 453); *in herb. De Candolle* ♀, Guadeloupe (Krauss, 1615); *in herb. Benth.*, Jamaica (Forsyth).
7. —— *rotundiuscula,* nob.—In Cuba: *v. s. in herb. Hook.* ♀, Cuba (Wright, 23).
8. —— *retinervis,* nob.—In Antillis: *v. s. in herb. De Cand.*, Puerto Rico (Bertero).
9. —— *Prioriana,* nob.—In Antillis: *v. s. in herb. Dr. Alex. Prior,* ♂ et ♀, Jamaica (Prior).
10. —— *valida,* nob.;—Hyperbæna reticulata, *Benth. l. c.* 50; —Pachygone Domingensis, *Eichl.* (*in parte*) *l. c.* 198.—In Antillis: *v. s. in herb. Hook.* ♀, Jamaica (Purdie).
11. —— *longiuscula,* nob.—In Cuba: *v. s. in herb. Mus. Brit.* ♀, Cuba (Wright, 1854).
12. —— *cuneifolia,* nob.—In Cuba: *v. s. in herb. Hook.* ♂, Cuba (Wright, 1853); ♀, Villa Monte Verde (Wright, 1104); *in herb. Mus. Brit.* ♂ et ♀, Cuba (Wright, 1853).
13. —— *crebriflora,* nob.—In Cuba: *v. s. in herb. Mus. Brit.* ♂ et ♀, Cuba (Wright, 1855).
14. —— *banisteriæfolia,* nob.;—Cocculus banisteriæfolius, *A. Rich. Ann. Sc. Nat.* xvii. 136; *Walp. Rep.* i. 95;—Cocculus oblongifolius, *Mart. in Fl. Beibl.* xxiv. *Append.* ii. 43; *Walp. Rep.* ii. 748;—Pachygone oblongifolius, *Eichl. Mart. Fl. Bras.* xxxviii. 197, tab. 47. fig. 1.—In Brasilia, *v. v.* ♂ in sinu Jurujuba, prov. Rio de Janeiro: *v. s. in herb. Mus. Brit.* ♂, Rio de Janeiro (Bowie).
15. —— *Columbica,* nob.;—Pachygone Columbica, *Eichl. l. c.* 198.—In Colombia.

[To be continued.]

XX.—*On the Muscular Force of Insects.* (Second Note.)

By Félix Plateau[*].

It will be remembered that in my former note on the muscular force of insects, I arrived, by determining the relations between the mean weights pulled, pushed, or raised by a great number of species, and the mean weight of each of these species, at the relative values of the strength of insects. From the comparison of these values I deduced the following law:—*In the same group of insects, the force varies inversely to the weight*—that is to say, that of two insects belonging to the same group the smaller presents the greatest strength. There were, however, some cases in which this law was not, or only incompletely, verified—namely, when species of the same group differed but slightly in weight: I justly attributed these exceptions to the insufficient number of individuals experimented upon; for having this year resumed these same trials, doubling the number of individuals (that is to say, raising it to twelve), I found the law above referred to perfectly confirmed, both by the mean relations and by the maximum individual relations, even with species differing so little in average weight as *Donacia Nymphææ* and *Crioceris merdigera*, belonging to the group Eupoda.

---

[*] Abstract, communicated by the author, from the 'Bulletin de l'Acad. Roy. de Belgique,' 2e série, tome xxii. For the former note see 'Annals,' February 1866.

I indicated this group of Eupoda as exceeding all others in traction-force. Fearing that this supremacy was only to be ascribed to the stiff brushes with which, besides the claws, the tarsi of these animals are furnished, and which enable them to adhere with great force to plants, I wished to ascertain whether the Longicorns, which possess the same accessory appendages of the tarsi, also surpassed other insects with simple claws; but both *Saperda carcharias* and *Strangalia armata*, with which I experimented on this point, gave me only results analogous, or even sometimes inferior, to those furnished by insects of weights respectively nearly approaching those of these insects, and only possessing simple claws. The supremacy of the Eupoda must therefore be attributed solely to a great muscular force, which is explained partly by the great volume of the posterior femora of those insects, and partly by their small weight.

I had no time, during my former investigation, to make experiments upon the leaping of the Orthoptera. The present note is devoted to this manifestation of muscular force. I have tried what is the maximum weight that these insects can move in leaping. The method employed is nearly the same as that of which I availed myself in the case of flight. I attach to the body of the animal, by means of a thread, a little ball of wax, taking care to make it at first too light, so that it may be easily carried away by the insect. I then increase the weight of this mass, by the addition of fresh portions of wax, until the insect can no longer raise it more than 1 centimetre in height. It will be easily understood that I could not go further; for the real maximum weight would be that which the insect could not raise except to an infinitely small extent, or, in other words, which would fix it to the ground; and it would have been difficult to know whether this point had not been exceeded. I will add that, in order to obtain the force developed solely by leaping, I always fastened together the wings and elytra, so as to prevent the insect from making use of those organs of locomotion. The mean relations representing the force were obtained, as in the other cases, by calculating the relation between the mean of the weights raised by the individuals of each species and the mean weight of the species. My experiments were made chiefly upon two species of Acridiidæ, *Œdipoda grossa,* and *Œ. parallela.* These species weighed respectively 0·646 gr. and 0·194 gr., and raised a mean weight of 1·064 gr. and 0·638 gr. The proportions indicating their relative force are therefore 1·647 and 3·288; and we see that, in the case of the leaping of the Orthoptera, we have a further verification of the law according to which, in the same group of insects, the lightest are comparatively the strongest.

The difference of structure existing between the Locustidæ and the Acridiidæ prevented my comparing the great Green Grasshopper (*Locusta viridissima*) with the above-mentioned Acridiidæ; I have, however, made some experiments on the Green Grashopper, and this animal, which is heavier than *Œdipoda grossa,* has given me a smaller proportion.

This fact, with others which will be found in my note, has led me to inquire whether the law according to which the smaller insects possess a more considerable force, instead of being limited to the subdivisions of entomological classification, does not extend to the whole class of Insects. When the twenty-one species on which I have experimented are arranged (for traction, for example) in the ascending order of their mean weights, we find that the series of corresponding mean relations which express the force, although manifesting a tendency to decrease from the lightest to the heaviest insect, nevertheless presents numerous departures therefrom, which must be attributed to the differences of structure in the genera in question. But the result is clearly defined if we divide the whole of the species tried into three groups, of which the first contains the lightest insects, the second those a little superior in weight, and the third the heaviest, and take for each of these groups the mean of the relations expressing the forces. This is what I have done. In the first group the weights, all less than 1 decigramme, go from 0·015 to 0·090 gr.; in the second the weights, all superior to 1 decigramme, go from 0·111 to 0·540 gr.; and in the third from 0·940 to 1·905 gr.

As regards flight, the insects upon which I have experimented being all very light, I have only formed two groups of them—that of the species weighing less than 1 decigramme, and that of the species of greater weight. The following table contains the results of these arrangements:—

		Number of Species.	Means of the mean relations.
Traction	1st group	9	26·2
	2nd „	9	19·0
	3rd „	3	9·2
Flight	1st group	7	1·3
	2nd „	7	0·5

from which we see that the mean forces are still in inverse proportion to the weights. It appears to me, therefore, that we may assume, in a general way, and without regard to zoological affinities, that the force of insects is more considerable in proportion as their size and weight are less.

I devote the concluding portion of my present paper to replying to some objections which have been raised by my former note. I think it needless to reproduce these objections, with the exception of a single one which has been made by the journal the editors of which have the kindness to lend me their pages at the present moment.

In speaking of the flight of insects I remarked that it did not in any case furnish me with such high results as traction and pushing, probably because insects have never, like certain animals, to transport from place to place burdens of considerable weight. The 'Annals and Magazine of Natural History' said, with regard to this passage, "M. Plateau seems here to have forgotten the Sand-Wasps, many of which carry caterpillars of comparatively large size to their burrows." I by no means deny that the *Sphegidæ* transport, by flight, caterpillars of considerable size, but I cannot admit that these caterpillars possess comparatively great weights. In support of my assertion I here give the results of experiments which I have made upon *Sphex sabulosa*. In the following table will be found the maximum mean weight which this species can raise by the force of its wings alone, and the relation of this weight to the mean weight of the insect:—

	Number of individuals.	Mean weight.	Mean maximum weight raised.	Mean relation.	Individual maximum relation.
Sphex sabulosa	8	gr. 0·066	gr. 0·042	0·636	0·800

These numbers superabundantly prove, it seems to me, that the *Sphex* cannot raise by flight alone an additional weight even equal to its own; moreover I greatly doubt whether, in the case of caterpillars exceeding this weight, or even merely equalling it, these insects do more than drag them along, as is shown by a curious observation made by the naturalist Boitard*, who saw this same *Sphex sabulosa* just mentioned, despairing of conveying by flight a caterpillar which it had just killed, get astride of its victim, raise this a little by means of its intermediate legs, and drag it to a great distance by walking with its anterior and posterior feet. It is therefore almost traction only that we have to do with here; and we know, from my investigations, how great may be the strength of insects under these circumstances.

XXI.—*Notulæ Lichenologicæ.* No. XII.

By the Rev. W. A. Leighton, B.A., F.L.S.

On the Cladoniei *in the Hookerian Herbarium at Kew.*

Since the publication of my paper on the *Cladoniei* in the November Number of the 'Annals,' I have accidentally discovered that if the hypochlorite of lime be immediately applied to specimens of *Cladoniæ* already moistened with hydrate of potash, some very remarkable reactions are produced. For instance, if only a very slight and scarcely observable yellow reaction be produced by the hydrate of potash, the immediate application of the hypochlorite of lime will bring out a full-coloured yellow reaction, which colour may either remain permanent or be eventually obliterated. This reaction is symbolized hereafter thus, K f + C +. In other cases, where the hydrate of potash produces a yellow reaction, that reaction is still further increased by the hypochlorite of lime (symbolized K + C +). Again, where the hydrate of potash brings out a yellow reaction, that coloured reaction is immediately obliterated by the hypochlorite of lime (symbolized K + C −). Again, where the hydrate of potash produces no reaction at all, the application of the hypochlorite of lime excites a most distinct and full yellow reaction (symbolized K − C +). And, lastly, in some species there is a double negative reaction, or, rather, no reaction at all takes place (symbolized K − C −).

This new mode of testing enables us to distinguish more accurately and definitely the limits of the different species or forms, and appears to afford a more satisfactory confirmation than that obtained by the application of the hydrate of potash alone.

---

* Curiosités d'Histoire Naturelle, Paris, 1862, p. 92.